A STUDY OF THE EFFECTS OF PLANE OF NUTRITION ON MILK SECRETION AND LAMB GROWTH IN ROMNEY SHEEP; AND THE EFFECT OF WEANING DATE ON THE GROWTH OF ROMNEY LAMBS.

A Thesis

Presented in partial fulfilment of the requirements

for the degree

Master of Agricultural Science
of the
University of New Zealand.

by

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March, 1952.

TABLE of CONTENTS

TABLE OF CONTENTS (Contd.)

I N T R O D U C T I O N

PART I - MILKING EXPERIMENT

The productivity of an animal depends on two factors, its potentiality, which is governed by its hereditary make-up, and the extent to which that potentiality is allowed to develop, this being regulated by the environment that characterises the habitat. The effects of genotype are obviously shown by the differences between breeds of stock in the amount and quality of meat, wool and milk they produce; but within breeds these effects are not so apparent though they have been conclusively demonstrated, e.g. yield and quality between flocks of Romney sheep.

Environmental influence on productivity is limited at the maximum level by the genotype, i.e. no matter how good the environment, the animal cannot produce more than the maximum ordained by the genes it possesses. Conversely, below the genotypic maximum, the environment can regulate the ceiling level of production. This interplay of factors is well illustrated by the adaptibility of different breeds of sheep to different habitats, e.g. the Romney is predominant in the North Island hill country while in the South the Merino and its crosses assume a greater importance.

Within a population with approximately common genotype, e.g. a single flock of uniform breed, the effects of environment below the threshold set by the genotype can be widely varied, e.g. the growth of lambs in a drought can be severely set back. It is with the effects of a particular factor of environment, i.e. nutrition, on the milk production and lamb growth of such a population that this investigation is concerned.

Owing to the small size and the varied topography of the country and the latitudes in which it is situated, the climate in which sheep farming is practiced in New Zealand varies greatly from province to province, from county to county and even from district to district. Soil and configuration changes are rapid and soil quality may differ widely in adjoining properties - these changes are naturally accompanied by differences in type and quality of vegetation and in the quantity and quality of the food available to stock.

The systems of sheep farming prevalent in New Zealand necessitate the moving of sheep from one type of country to another at different stages of their lives, so that they are called upon to produce in markedly differing environments within the space of a few years. The fat-lamb farmer depends on the hill-country man for his supply of ewes to be mated with Down rams; ewes for the hill-country breeding flocks move from the stud farms to the hills and the flocks on the poorer and higher hill-country obtain their replacements from those on the easier land. There is a constant flow of sheep from one farm to another, one district to another and from one environment to another. It is of interest and practical value to know what effect this variation in living conditions has on the milk of the ewe.

The importance of studies on the milk secretion of non-milking breeds of sheep has been stressed by other investigators viz. Bonsma (1939, 1944), Wallace (1948), Barnicoat, Logan and Grant (1949), Ritzman (1917), Fuller and Kleinhanz (1904) Niedig and Iddings (1919), and Pierce (1934, 1938).

The main justification of such studies would appear to lie in the dependence of the lamb on the

milk yield of its mother for its early growth and development. Wool and meat are the major products of the sheep industry in this country and, of the meat, fat-lambs make up the greater portion (1949-50, sheep - 4,268,000: lambs - 12,719,000 slaughtered at Export Works (Census and Stats. Dept., N.Z., 1951)).

The research studies of Hammond (1952), McMeekan (1939) and Wallace (1948) have emphasised the importance of a high plane of nutrtion in early life to allow the young animal to grow to the fullest extent that its hereditary potentialities will permit; the rate of growth plays an important part in the final development of the animal, the fastest rate giving the best developed and balanced and the largest carcase.

A well grown animal is required both by the fat-lamb exporter and the breeder of flock replacements; the former looks for the lamb that will produce maximum meat of the best quality in the shortest time, which is achieved by producing lambs "fat off the mother". The breeder needs a young animal that will produce a good fleece, rear its lambs well, produce for a number of years and provide a profitable carcase at the end of its useful life. These standards will only be met by stock which have been themselves reared underoptimum conditions, which involves a high nutritional plane in early life, i.e. they must be the progeny of ewes with a plentiful milk supply.

The milking experiment laid down here was designed to furnish information on the milk supply of the Romney ewe and the growth of her lamb under different planes of nutrition, the sole feed of both groups being natural pasture. It commenced soon after tupping in the autumn and involved following the lactations of over thirty ewes through an average lactation of fourteen weeks.

Chemical analyses on milk samples were done throughout this time and the results compared between planes and between stages of lactation.

Liebig first pointed out that the differences in the composition of milk of various species is related, in a general way, to the shape and slope of the growth curve. Different species require different lengths of time to double their birth weight, the length of time being inversely proportional to the concentration of the various milk constituents, e.g. Espe (1941) summarised this in a table of which the following is an extract :-

TABLE I

RELATIONSHIP OF GROWTH RATE TO MILK COMPOSITION

Species	Days required to double Birth weight	Compcsition of milk percent			
		Proteins	Ash	Calcium	Phosphoric acid
Horse	60	2.0	0.3	0.124	0.131
Goat	22	3.7	0.8	0.197	0.284
Sheep	15	4.9	0.8	0.245	0.295
Cat	10	7.0	1.0	-	-
Rabbit	6	10.4	2.5	0.891	0.997

Little is known of the effect of the composition of the milk on the growth of the young within a breed but Gaines has obtained a high correlation between fat percentage and energy yield of milk. In this investigation an attempt has been made to compare the relationships between lamb growth : milk yield and lamb growth : milk energy.

PART II - WEANING EXPERIMENT

Since the production of lambs is of such importance any study which aims at increasing the efficiency of that production is worthwhile. In this investigation, in conjunction with the milking experiments above indicated, other experiments were laid down to determine the effects of early weaning and inoculation with rumen micro-flora on the growth of lambs.

Current practice is to wean lambs when they are in the vicinity of 70 pounds liveweight, i.e. when they are 14 - 16 weeks of age; it would be of considerable advantage if they could be separated from their dams (without harm to the carcase produced) some weeks earlier.

Firstly, management would be facilitated. The ewes would be removed from competition with their lambs for feed and could be removed to the poorer parts of the farm, leaving the better areas for the lambs and other more needy stock. If the ewes were to be sold off the place they could be quitted earlier when they would be in better condition - feed would be saved that could be used for the fattening of store stock thus resulting in a direct increase in the production per acre. If they were to be kept for mating again, the ewes would be very useful for controlling growth, for "cleaning up" and in general pasture management.

Secondly, the shorter lactation period involved would be beneficial to the ewes themselves. It would give them a better chance to recover from the effects of bearing and rearing the lamb which means they would sooner be fit for mating again. It would have a beneficial effect on the wool production, for Bosman (1937) has shown in South Africa that while pregnancy does not influence the fibre fineness of Merino wool significantly, lactation and

the suckling of the lambs reduce the fibre fineness, the fleece density and the wool production appreciably.

Thirdly, it has been shown that the correlation between the yield of milk and the weight gains made by the lamb decreases rapidly towards the end of lactation (Wallace, 1948). This relation is also apparent from the curves for milk yield and lamb growth obtained by Bonsma (1939) and Barnicoat et al (1949) i.e. as lactation progresses the lamb relies less and less on the milk of the ewe and more and more on the other sources of feed available. The lamb may well be able to grow a high grade carcase without the long suckling period which common practice indicates that it needs.

PART III - INOCULATION EXPERIMENT

Much work in recent years has established the importance of rumen micro-organisms in the digestive processes of ruminant animals, (various authors) particularly in the breakdown of fibrous feeds into a form easily assimilated by the animal and in the elaboration of proteins, sugars and vitamins. When the young animal is born it lacks these organisms and must secure them from outside contamination.

The young ruminant has a digestive system suited for the readily available food, i.e. milk, that it is ingesting, a digestive system that resembles more the simple stomach of the mono-gastric animal than the complicated system of the ruminant animal. As its diet changes from milk only, to milk and forage and finally to all forage, the characteristic ruminant digestive system is developed. The animal with this digestive system is much more efficient in utilising fibrous feeds than the one with the simple stomach and therefore the sooner this system can be developed

the greater will be the utilisation of fodder and the greater will be the weight gains made, leading to more efficient production.

Various studies have been made on the methods of observing, identifying and describing the micro-organisms of the alimentary tract of ruminants notably those of Smith and Baker (1938), Pearson and Smith (1943), Van der Wath and Mayburg (1941), Baker (1943, 1949), Moir (1951), William and Moir (1951) and Gall and Huhtanen (1951). In a series of papers commencing in 1947, Pounden and Hibbs, Conrad, Hibbs, Pounden and Sutton, Pounden, Ferguson and Hibbs, have described attempts to increase the speed of development of a typical rumen micro-flora and fauna in dairy calves by inoculating them with rumen contents or cuds taken from mature animals.

Cuds were taken from the mouths of mature cows and placed straightway in the posterior of the mouths of the calves; microscopic examinations of rumen contents were made and the stage of development of the mirco population judged by the identification of several species of bacteria believed to be associated with the normal population. Gram stained smears and direct observation were the methods used.

They found that the uninoculated calves took much longer to build up the normal population than the inoculated ones even when they were on pasture together and that when uninoculated calves were isolated from other animals the rate of build up was very slow indeed.

Inoculated calves suitably fed (the diet e.g. ratio of grain to hay, can markedly influence the numbers and types of organisms present in the rumen) maintained the most satisfactory level of ascorbic acid in the blood plasma during the first few weeks of age. They

had smoother coats and a general more healthy appearance than similarly fed but uninoculated calves. The inability of calves on pasture to get the characteristic micro-organisms had no effect on gain in weight or general health and the explanation of this appears to be that substitute organisms can do a creditable job; however, the point is made that micro-organisms that have developed over a long period of time in the environment of the rumen can be expected to function most efficiently in this organ.

In a later experiment, Conrad et al (1950) found that when roughage constituted the entire dry feed, cud inoculations aided in providing micro-organisms which became established in uninoculated calves. The inoculations were observed to stimulate hay consumption at an earlier age than when no inoculations were given.

When calves were raised in segregation from other animals and without inoculations, no differences in weight gains was noticed but there were differences in appearance, the uninoculated calves being "pot-bellied" and rough coated.

A preliminary trial was therefore carried out to investigate the possibilities of a like procedure with lambs, the measure of effect being the comparative gains made by inoculated lambs and a control group over a specified period. If the results are satisfactory and a suitable practical technique can be devised, a further increase in the growth rate and the efficiency of production may be obtained.

OBJECTS OF THE INVESTIGATION

The experiments reported below find ample justification in the considerations set out in the foregoing paragraphs; the objects of the work may be briefly summarised thus :

1. A study of the effect of a lowered plane of nutrition on the Romney ewe with special reference to -

(a) Milk yield.

(b) Energy yield.

(c) Composition.

(d) Growth of the lamb in relation to (a), (b) and (c).

2. A study of the effect of early weaning of lambs on their subsequent weight gains and slaughter gradings.

3. A study of the possibilities of increasing the growth rate of lambs by inoculation at an early age with rumen micro-flora obtained from mature sheep.